

Deriving travel costs with web based travel information centers for various travel patterns

Eve Pytel (Corresponding Author)
Planner
TranSystems Corporation
222 S. Riverside Plaza
Suite #2320
Chicago, IL 60606
Ph: (312)-669-9601 ext. 1232
Fax: (312) 669-9606
Email: egpytel@transystems.com

Sue McNeil
Director (Urban Transportation Center),
Professor (College of Urban Planning and Public Affairs)
University of Illinois at Chicago
412 S. Peoria, Suite 340, (MC 357),
Chicago, IL 60607
Ph: (312) 996-9818,
Fax: (312) 413-0006,
Email: mcneil@uic.edu

Prepared for the Transportation Research Board Annual Meeting
Washington DC
January 2003

July 16, 2002

Word Count = 4866 +graphics (5*250) = 6116

ABSTRACT

The impact of the evidence of the need to trip chain and barriers to trip chaining is considered in the context of both the traditional commute and reverse commute in the Chicago region. The user costs associated with trip chaining in the Chicago region using the Chicago Transit Authority, Pace Bus, and Metra Commuter Rail are examined through a simulation of 588 work trips. Simulation of data for analysis provided the results that could not have been determined with the household travel data sets available to the Chicago region. Simulation was done through use of a web based travel information center hosted by the Regional Transit Authority. Those results show not only the cost comparison of trip chaining (based on the assumption that a child needs to be dropped off at an elementary school) but also vast differences in travel time for traditional and non-traditional commuters. Six scenarios were examined to compare the travel costs and time difference of traveling from home to work with traveling from home to an elementary school to work controlled to examine the effects of reverse commuting on trip chaining.

Methods for enabling transit users to trip chain are examined on both the local and regional level and involve the coordination of traditionally non-transportation related organizations. Fare policy, transportation policy, housing policy, company policy and the policies of municipalities concerning large-scale employers are essential components for enabling transit users to trip chain. This is particularly relevant in exploring options for welfare to work transportation.

BACKGROUND

Complicated travel patterns present barriers to both transit agencies and users. Those complicated travel patterns may involve trip chaining and/or reverse commuting. At the same time, agencies have begun to provide interactive detailed web sites for commuters to plan their trip making. The depth of information provided on the Regional Transportation Authority's website allowed for the simulation of 588 trips to compare the cost of trip chaining to not trip chaining for both traditional and non traditional commutes for transit users in the Chicago region. While the issues are of particular interest to welfare-to-work transportation, they are of broad relevance to both transportation agencies and commuters.

This paper details the differences in the quality of service received by reverse commuters and the difference in the costs to users between traditional and non-traditional travel patterns in the Chicago Region. Spatial analysis in tandem with a cost comparison provided the groundwork for the methods to mitigate the costs and quality difference of travel for those who trip chain and reverse commuters. This paper presents the methodology of the study, findings concerning the costs of travel and methods for enabling transit users to trip chain even in a reverse commute setting. The paper concludes with a discussion of the quality of the data required to do this sort of analysis and the opportunities that this study provided.

METHODOLOGY

This section discusses the methodology for the research. Our objective in devising the methodology was to explore the inequities of non-traditional commuting. This includes a comparison of traditional commuting to non-traditional commuting both with and without trip chaining. Differences in out-of-pocket-cost and total time cost were used as evaluation measures. The following definitions are used to describe travel patterns

- Traditional refers to commuting to the center of a downtown area without accomplishing other trip purposes *en route*.
- Non-traditional refers to either reverse commuting or trip chaining. Within that subset reverse commuting refers to traveling either from a city to a suburb or from a suburb to a suburb.
- Trip chaining refers to accomplishing multiple trip purposes in a home based or work based trip.

This study compares six very different types of work commutes. These trip types include:

- Traditional
- Down town with a trip chain
- Reverse commute to an inner suburb
- Reverse commute to an inner suburb with a trip chain
- Reverse commute to an outer suburb
- Reverse commute to an outer suburb with a trip chain

For the experiment, six scenarios were examined to compare the travel costs and time of traveling from home to work. Trip chaining was introduced through a trip from home to an elementary school (assuming an elementary school age child needs to be dropped off). The six scenarios were performed with the same home locations, same elementary school locations, but with three different work locations.

To conduct the analysis, data were synthesized for Chicago. These data included origin points (home locations), elementary school locations, and destination points (work). Travel time and travel cost were estimated for travel using public transit. The process for developing the synthesized data is as follows.

Origin Points

The origin points were selected from the Chicago White Pages. The first 10 residential listings of each letter were entered into a spreadsheet. From the 260 addresses, the sheet was sorted to drop out duplicated addresses 100 addresses were randomly selected to be home addresses, or origin points from where the travel was simulated. The weakness of using the phone book to select addresses was that it excluded the chance of getting persons too poor to own a phone. The addresses were then plotted in GIS as shown in Figure 1.

Setting the Trip Chain

This study chose a school drop off for the trip chain. Each home address was assigned the closest Chicago Public School operated elementary school for its trip chain. The list of elementary schools was created with lists of all of the schools, in the five Chicago Public Schools Regions.

The assumption that elementary schools could be part of a trip chain relied on the supposition that children from age 4-8 attend them and it is assumed that an adult accompanies children less than 9 years of age to school. The origins were matched to the schools using GIS.

The distance between origins and schools was calculated in this stage to see whether the commuter would need to use motorized transportation to drop off the child. Refusal distance of pedestrians, here defined as the distance at which pedestrians demand to use motorized transportation, is assumed to 0.8 km (½ mile) rather than 0.4 km (¼ mile). Refusal distance is generally assumed to be 0.4 km (¼ mile) (Khisty, 1998). The refusal distance was increased to a 0.8km (½ mile) because the traveler must choose whether to take the child on public transit en route to school. It is assumed that the parent will attempt to make the fewest trips possible using transit and walk an additional 0.4 km (¼ mile.) With this formulation, 47% of the commuters will make one trip using transit before they go to work.

Determining Work Addresses

The first address for the analysis used was 1 North State Street, central to the Chicago Central Business District (referred to as “Loop”). The other work locations were selected from jobs that required minimal experience and a high school diploma or GED. These jobs were found in the *Chicago Sun Times* (on Sunday, January 20, 2002). Unfortunately, many work sites had to be eliminated because they did not have a street address. The listings were imported into a spreadsheet and then randomly selected. The second work site selected was in Geneva, Illinois (60 KM west of Chicago) and it yielded very extreme results. The third work site chosen was Arlington Heights (20 KM northwest of Chicago), which was more plausible because it is served by public transit. The work locations were plotted in GIS as shown in figure 2.

The Trip Planner

The travel costs were derived using the trip planning website with the obtained origins and destinations. In the Chicago region the Regional Transportation Authority (RTA) is responsible for providing travel information for the service boards: Chicago Transit Authority (CTA), Metra, and Pace Bus. In the past, telephone operators provided this information at RTA. RTA currently hosts a web page devoted to interactive travel information known as the RTA trip planner (RTA02).

The RTA trip planner on the RTA web site was used to examine the travel paths between set origins and destinations. To that end the trip planner was set to give the travel directions from one point to another using public transportation in the Chicago region. This section will discuss how the trip planner was used and the information recorded from the trip planner.

The trip planner was used to get the route, travel time and cost of every trip used in the experiment. The trips were all based on the following choices made at the travel information center website:

- Normal workday
- Desired departure time: 7:00 am.
- Preference to walk no more than 0.8 km (½ mile)
- Preference for the quickest commute

The data were then used to compare travel costs in time, money and the number of transit bordings of individual trips straight to work with trips that combine the trip purpose of work with a child drop off. Summary tables were made to compare the mean travel costs of all three-trip making groups straight to work trips and tripchains. The results were also spatially analyzed in a GIS. In addition, the data display in GIS clearly delineates which work locations are accessible for which residents evidencing who has what level of transit service.

RESULTS

This section discusses the results of the research. The results show the discrepancies between costs for traditional and non-traditional commutes. This research suggests that many factors influence the costs of trip chaining in Chicago. The initial starting point, the location of the elementary school, the work addresses, and the CTA, Metra, and Pace systems all heavily influence the cost of travel. This section gives the results and explanations.

Table 1 provides a basic summary of the results in terms of average travel time, out-of-pocket travel costs (fares) and number of transfers for each of the three destinations both with (indirect) and without (direct) trip chaining. The table shows that the transit network is most conducive to the traditional work commute. The traditional commute is the least expensive, requires the least time, and the fewest transfers. At the same time, the most expensive trip is the nontraditional trip to work in Geneva with a child drop off.

The results of this experiment show that it is burdensome to commuters when the transit system defines the parameters for a commute in a manner that does not serve the needs of commuters. Fare structure is the most direct way that a transit agency may communicate its objectives to its users. The current fare structure in Chicago is \$1.50 for a base trip with unlimited rail transfers while on the system and \$1.80 for an initial trip with up to two transfers within a two-hour period from when the trip started. There is reciprocity with Pace but Metra has an entirely separate destination based fare structure. The CTA and PACE fare structure communicates the manner in which commuters are intended to travel. That appears to be from home to work. This fare structure allows most people to get from home to work directly, but not allow for a child drop-off in the midst of the trip. While commuters who travel to the Loop may have enough transfers to allow for a trip chain, commuters traveling to destinations outside the Loop do not.

In terms of monetary cost, there is very little difference for the cost of going to the Loop and making a child drop off *en route* to the Loop, the median and mode cost is still \$1.80. Furthermore that occurrence is a function of the fare structure shared by the Chicago Transit Authority and Pace Bus. The Arlington Heights case tells a different story. In the direct trip to Arlington Heights only 4 commuters ran out of transfers (made four or more transit trips), but in the Arlington Heights scenario with a child drop off 37 commuters ran out of transfers. In other words, 86% of the 43 commuters who had to transfer to drop off a child had to pay the base fare of the CTA twice or \$3.30 (two base fares and one transfer). The comparison of the direct trip to the trip chain for the work trip signified where the fare structure does not work for reverse commuters. Policy wise this was the most important result because research performed by the Urban Transportation Center on welfare reform evidenced that welfare to work participants and the working poor does need to use public transportation to access jobs in the inner and outer

suburbs and that the welfare to work population had very complicated travel patterns that may be due to single motherhood. (Thakuriah, 1999)

Time is very important in comparing the three destinations. For the Loop all commutes were under 90 minutes and for Geneva all commutes were over 90 minutes. Arlington Heights provided a rich mixture of commutes ranging from one hour and 22 minutes to four hours (Figure 3). Figure 3 shows the locations of commutes to Arlington Heights over 90 minutes, which tended to be south of the city.

IMPLICATIONS OF THE COST COMPARISON

Spatial Analysis of the results suggested the following possible reasons for concentrations of persons who spent more than 90 minutes on transit:

- Home Location
- Work Location

Each of these reasons is considered in more detail with respect to two questions. Those questions: How does fare structure influence trip chaining using transit? How are different commute types affected by fare structure considered with respect to home location, location of child drop off in proximity to transit and home, and finally work location?

Fare structure influences how well commuters can trip chain

Fare structure is an important measure of how well people can trip chain. This experiment tests traveling from an origin directly to a destination against a trip that combines the trip purpose of commuting to work with a child drop off. In the case of commuting to the Loop, trip chaining did not significantly increase travel costs. Since 57% of the commuters had paid for one transfer, for them the second transfer was free. Only 7% of the commuters had used both transfers to travel directly to the Loop and of that 7% only three lived more than .5 miles from their elementary school. Therefore, for workers traveling to the Loop the CTA fare structure allows for one trip chain for the majority of riders.

The results from the Geneva location mirrored the Loop. This occurred because traveling to Geneva essentially combines traveling to the downtown area with a Metra trip to Geneva. Table 1 shows how little change occurs when traveling to Geneva directly or with a combined trip purpose.

For Arlington Heights, there were significant differences in fares for combining trip purposes. This occurred because 67% of the commuters made three trips to get to Arlington Heights. Therefore 67% could not combine a second trip purpose. Figure 4 shows the jump from persons paying \$1.80 to \$3.30 to be able to trip chain. Similarly, 86% of the 43 commuters who must use a transfer for the child drop off made four or more trips in the drop off scenario.

The results show that the ability to trip chain is affected by the origin, the destination, placement of the trip chain, the service connecting those points and the mechanisms in the fare structure.

How different fare structures impact this group

The Chicago Transit Authority and Pace Bus have typical fare structures. Although some agencies have moved to zone based fares, the majority of transit agencies used a base fare with a transfer cost under the cost of a second full fare or a free transfer. For example, only two of twenty transit agencies were zone-based systems (Pytel2002). This section will discuss the cost implications of fare structures for this group.

Some transit agencies have been switching from uniform prices for trips to zone based fare structures. For example, Washington DC's Metro is zone based. While it seems equitable that people who travel further distances should pay more, in examining reverse commutes that may not be the case. If the distance-based fare were created so that the largest fare does not exceed the cost of the base fare and the transfer then it could be beneficial for these people. However, zone based fare systems may not be a viable mechanism for tripchaining. The problem is that zone based systems tend to have a minimum fare that exceeds the cost of a transfer. In this case, the transfer system is the least costly and the distance-based system is the most costly. The insight gained by this type of travel cost analysis allowed for us to see whom the system is most costly to. Furthermore spatial analysis combined with consideration of policies affecting Chicago allowed for the consideration of what might be done to reduce the cost of travel in time and out of pocket cost for reverse commuters in Chicago.

METHODS FOR ENABLING TRANSIT USERS TO TRIP CHAIN

Restructuring the CTA and PACE Fare

This analysis has solely represented the demand side of the problem. More research is needed to understand the supply side of the problem. However, there are two ways to alter the CTA and PACE fare structure without dramatically changing it. The fare structure could change the amount of transfers allowed or change the time-period for using transfers. The travel time analysis shows that changing the time limit for transfers would not significantly impact the ability of commuters to combine trip purposes; however, changing the number of transfers allowed would greatly facilitate a commuter's ability to trip chain. By adding an additional transfer, 67% of the commuters to Arlington Heights would be able to make one or more stops to accomplish other tasks without being priced out of the system. This means they would not have to pay a base fare twice in the course of one trip chain. For transit agencies simply increasing the number of transfers may be fiscally not feasible; whereas, increasing the base fare while increasing the number of transfers allowed may work. Increasing the base fare is also an equity measure in that it reduces the cost discrepancy between traditional and non-traditional commutes.

Supporting Monthly Passes for Needy Commuters

This research has assumed that the commuters will pay for each ride individually. Monthly passes at a cost of \$78 with unlimited travel would save money for this population and make trip chaining a moot point. However, monthly passes would constitute a large out-of-pocket expense for households with significantly low incomes. Provision of monthly passes could lead to major cost savings for welfare clients who are unable to purchase monthly passes. Similarly daily passes at a cost of \$5.00 a day would also save \$1.60 a day for those who would pay \$3.30 on

their way to work and return home. The CTA provides many types of passes and has a reduced fee for riders who qualify. Provision of monthly, weekly or daily passes for welfare clients could result in great cost savings for the welfare clients. Job Access and Reverse Commute funds could be used to pay for passes. For the working poor, who are not eligible for TANF funds or JARC services, employers could be encouraged to pay for monthly or weekend passes or offer other commuter benefits.

The Need for New Services

The most significant indication of the need for new sorts of services was evidenced by the Geneva run. The trips through the Loop to go to the employment site in Geneva displayed the inefficiency of the transportation system for people who must commute from outside of the city center to another location outside of the city center.

This problem is recognized by the CTA and the proposed Circle Line or Super Loop appears to reduce travel times for commuters who currently travel into the Loop to go to destinations outside of it (Chicago Sun Times, 2002). The CTA press release for the Circle Line used an example for travel to O'Hare airport. The example is useful because O'Hare is at the heart of the heaviest job growth for 2020 according to one Northern Illinois Planning Commission projection without. The example of a near north side resident shaving 10 minutes off a trip to O'Hare implies that anyone living further out than the near north side would have comparable time savings. Lastly, the Circle Line would provide additional free transfer locations (Chicago Sun Times, 2002). This may not reduce the number of legs in a trip, but it would reduce the out-of-pocket cost and could offer transfer sites protected from transfer fees.

Location Efficient Mortgages and the Company Town Reconsidered

The work locations cannot be said to be the entire problem. Research shows that home locations do affect travel because of the interaction between the locations. Home locations could be moved to reduce travel. Several programs like Location Efficient Mortgage (LEM) allow people to take extra debt to enable them to purchase a home close to public transportation. LEM may also be able to get people closer to work to reduce the costs of travel (Sprawl Symposium 2001). LEM provides a service for people who have some savings and are prospective homebuyers and not working poor.

Company towns with mixed-use developments may serve the working poor best. Company towns, thought to be a relic of the late 1800s are reemerging as companies take responsibility for the burdens they place on workers. Now called, *Employer Assisted Housing*, employers may provide services to workers that do not exert the criticized social control over workers of the Company Town of the late 1800s. Such housing developments may greatly reduce the travel needs of workers through concentrations of schools and shopping.

Housing arrangements may provide solutions to some problems, but their implementation may be very complicated and unattractive to many households. In the age of two earner households, relocating to one job may place more burdens on the other earner. Other barriers may include housing tenure outlasts job tenure and people may feel socially isolated if they move from their homes (Persky, 2002). Housing choices are long-term decisions and the travel costs are the

outcome of housing choices. Housing policies do present some solutions, but may be unattractive to many workers.

Mixed Use Development and Livable Communities

Reducing the number of trips, the length of trips and the cost of trips made have been a focus of the Livable Communities program funded by TEA-21. Livable Communities funded the creation of the Reistertown Metro Tot Stop. This project built a daycare facility at a commuter rail station in Reistertown, Maryland. Projects like this reduce the number of trip destinations for commuters (Pytel, 2001).

CONCLUSIONS

This research has investigated the factors that shape to what extent the CTA, PACE and Metra facilitate non-traditional tripmaking. From the comparison of the six trip types, it is clear that it is easiest to use public transportation in Chicago for the traditional commute to the downtown area for work. In addition, it is most costly in time and money for the reverse commute to Geneva.

The CTA and PACE fare structure allows for combined trip purposes for the traditional commute, but not for the reverse commute. While the ability to combine trip purposes maybe accidental for the CTA, it greatly increases the value of that trip. Since those commuting to Arlington Heights cannot trip chain and are already spending much more time in transit, they are doubly burdened in comparison to the Loop commuters.

Even though the CTA and PACE fare structure does not allow for 83% of the Arlington Heights commuters who used transit for the child drop-off to trip chain, they still have one of the best systems for reverse commuters. As more transit agencies move toward zone-based fare structures more people who need to trip chain may be not be able to do so. The CTA and Pace fare structure may be criticized for being outdated but it remains one of the best for people who need to trip chain. The strength of the fare comes from the two transfers for a lump sum. This lump sum means that people who transfer once or twice pay the same amount of money. That sort of fare structure is an equity measure that should be preserved and could be expanded.

The major policy issue for alternative trip definitions is that it is costly for non-traditional users when transit providers define trip in a traditional manner, home to work with no deviation. The prevalence of nontraditional transportation use is being addressed by transportation funding packages like Job Access and Reverse Commute (JARC). While JARC targets TANF clients, they are not the only ones who travel in nontraditional ways. Many researchers have shown that woman between 18 and 50 make the majority of household related trips and work. Working mothers of all income groups are traveling more than men are and in nontraditional ways (McGuckin, 1999, Spain, 1999, Rosenbloom 1999). The policy implications concern transit provider policy, federal transportation policy, welfare and housing policy.

Deriving travel costs in this way provides information for solely demand side analyses. But for this region this process currently represents one of the cleanest ways to create data sets for studying transit users who either transfer within one service provider, or to another service

provider. This demand side analysis has illustrated how Chicago's transit providers, CTA and PACE could modify their fare structures to allow more transfers for reverse commuters to combine trip purposes. To recap, for the working poor and welfare assisted commuters, the provision of fare cards by caseworkers or employers could lead to substantial cost savings for workers. Policy implications for housing locations include the LEM and employer assisted housing programs to reduce commutes for workers. Lastly this research shows the value of Livable Communities projects like the Reistertown Metro Tot Stop, which reduce the number of trips needed by creating mixed use developments at transit stations. Moreover this project has shown how web based travel information centers may be used to simulate trips. These tools allow for the analysis of not only how one service provider performs, but for Chicago, how the network of commuter rail, rapid transit and suburban bus work and do not work together.

References

1. Book

Khisty, C. Jotin, and B. Kent Lall. Transportation Engineering: An Introduction, Second Edition, Prentice Hall, Englewood Cliffs, NJ, 1998.

2. Web Page

RTA Trip Planner: Travel Information Center. July 27, 2002.
<http://tripsweb.rtachicago.com/>

3. Report

(Thackuriah 1999) Thackuriah, Piyushmita, et al. *Implications of the Welfare Reform Law on the Suburban Chicago Transit Demand, Final Report*. Urban Transportation Center. (27,)

4. Thesis

(Pytel, 2002) Policy Implications of Alternative Trip Definitions. University of Illinois at Chicago, 2002

5. Newspaper Article

Chicago Sun Times March 12, 2002. *CTA Floats Circle Line Plan*.

6. Conference Proceedings

(Sprawl, 2001) Urban Transportation Center Fall Sprawl Symposium Proceedings.

7. Book

(Persky, 2000). Persky, Joseph and Weiwel, Wim. When corporations leave town: the costs and benefits of metropolitan sprawl. Wayne State University Press 2000. (28-31, 47-48).

8. Conference Proceedings

(Pytel, 2001) Pytel, Eve. Between Walking and Driving: An Examination of Transportation Opportunity for Welfare Recipients (Metropolitan Conference on Public Transportation Research, June, 2001)

9. Conference Proceedings (McGuckin, 1999) McGuckin, Nancy A., and Elaine R.

Murkami.1999. "Examining Trip-Chaining Behavior: Comparison of Travel by Men and Women." Paper presented at 78th Annual Meeting of the Transportation Research Board, January 1999, Washington, DC.

10. Government Report

(Spain, 1997) Spain, Daphne. Societal Trends: The Aging Baby Boom and Women's Increased Independence. Federal Highway Administration, U.S. Department of Transportation, Order No. DTFH61-97-P-00314. <http://www-cta.ornl.gov/npts/1995/Doc/SocTrends.pdf>

11. Government Report

(Rosenbloom, 1995). Rosenbloom, Sandra. (1995). "Travel by the Elderly," *Demographic Special Reports: 1990 NPTS Report Series*. Washington, DC: Federal Highway Administration, U.S. Department of Transportation. (3-49)

List of Figures

Figure 1. Origin (Home) Locations

Figure 2. Work Locations

Figure 3. Home Locations of Commutes over 90 Minutes to Arlington Heights

Figure 4. Histogram depicting the change in Fare for commuters to Arlington Heights

List of Tables

Table 1. Average Travel Times and Costs by Destination

Home Addresses

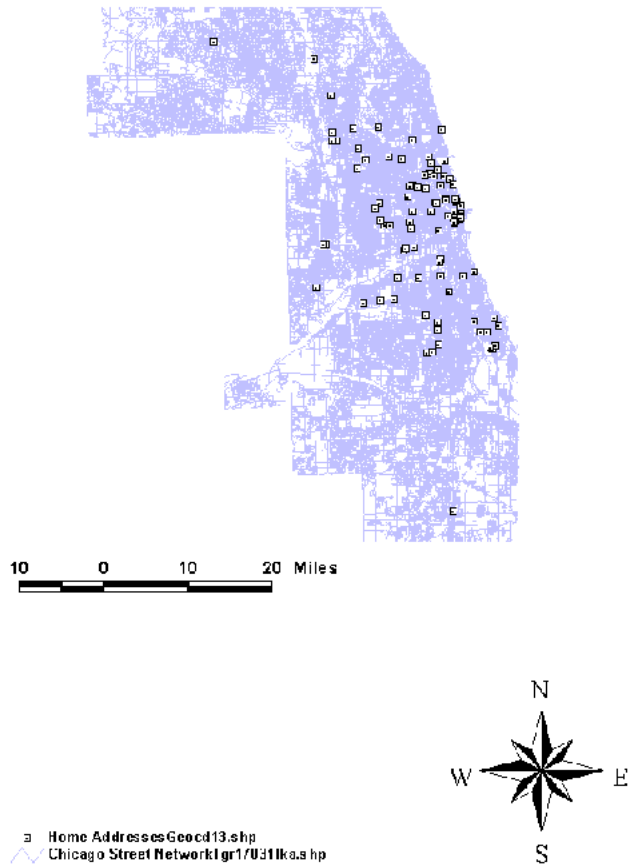


Figure 1. Origin (Home) Locations

Map of work opportunities in the six county region

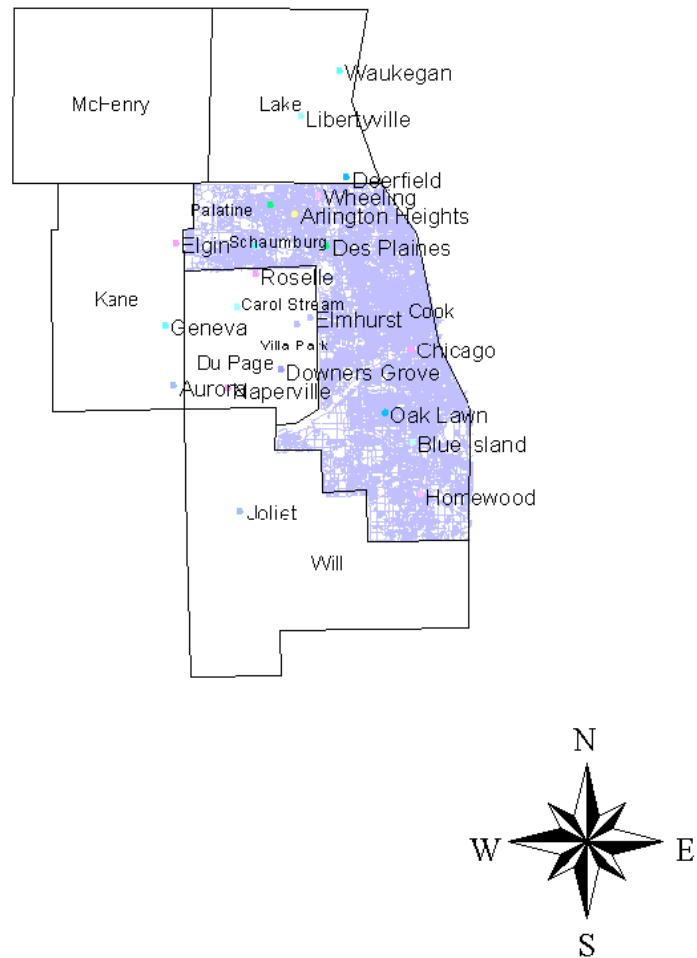


Figure 2. Work (Destination) Locations

Arlington Heights: Households with Travel times over 90 minutes

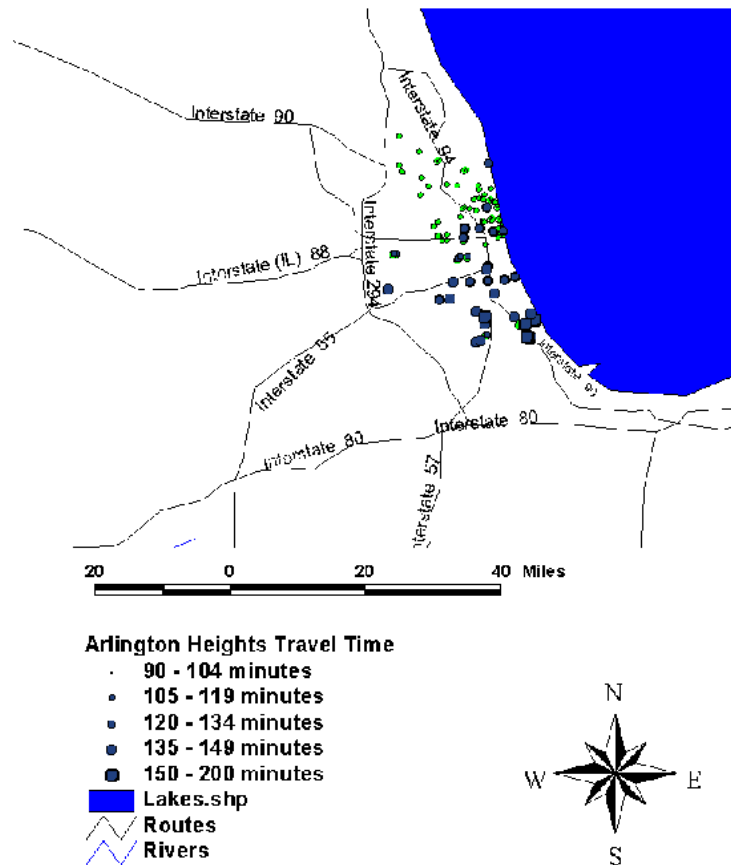
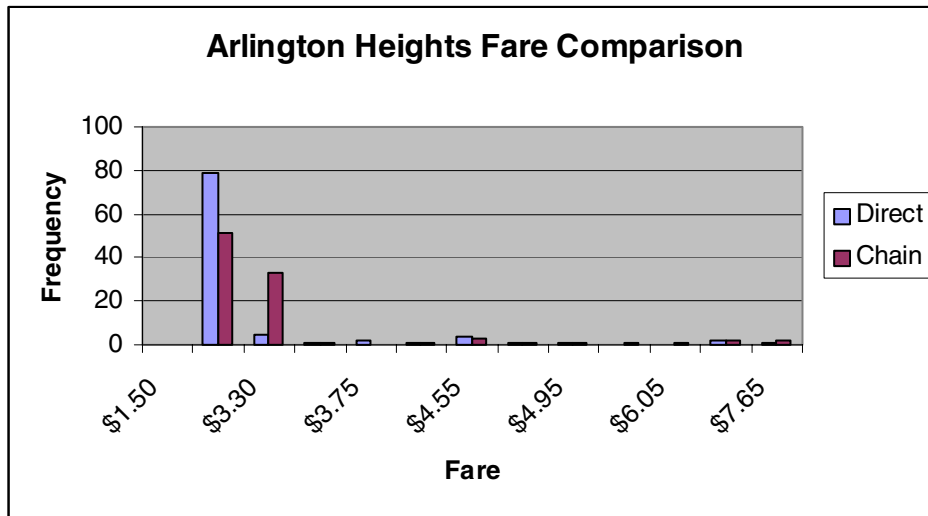


Figure 3. Home Locations of Commutes over 90 Minutes to Arlington Heights

Figure 4. Histogram depicting the change in fare for commuters to



Arlington Heights

Table 1

Destination	Trip Chain	Out-of-Pocket Cost (\$)	Travel Time (Hours: Minutes: Seconds)	Transfer Trips (#)
Loop	Direct	\$1.57	0:33:00	1.71
	Indirect	\$1.80	Time > 0:33:00	2.40
Geneva	Direct	\$6.23	2:21:48	2.34
	Indirect	\$6.23	Time> 2:21: 48	2.95
Arlington Heights	Direct	\$2.27	1:43:36	2.69
	Indirect	\$2.78	Time> 1:43:36	3.26

Table 1. Average Travel Times and Costs by Destination